"Express Mail" mailing label number EL485650305US

Date of Deposit 4-10-2000

Atty Docket No. **00P7572US**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

This is a U.S. Patent Application for:

Title: **SYSTEM AND METHOD FOR REINTERPRETING TOS BITS**

Inventor #1: William J. Beyda
Address: 21580 Edward Way, Cupertino, California 95014
Citizenship: USA

Inventor #2: Rudolf Bitzinger
Address: 1850 Nantucket Circle #247, Santa Clara, California 95054
Citizenship: Austria

Assignee: Siemens Information and Communication Networks, Inc.

SYSTEM AND METHOD FOR REINTERPRETING TOS BITS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to communications systems and, in particular, to an improved system for providing quality-of-service (QoS) in a Voice over IP (VoIP) system.

DESCRIPTION OF THE RELATED ART

The Internet Protocol (IP) is one of the most popular packet communication and networking protocols being used today. It finds use both on the Internet and in wide area networks (WANs) and local area networks (LANs), such as asynchronous transfer mode (ATM) and Ethernet networks. The promise of inexpensive voice telephony using the Internet has led to extensive interest in "Voice over IP" (VoIP) and "Telephony over LAN" (ToL) applications. In particular, several IP telephony protocols have been developed, including the H.323 Recommendation suite of protocols promulgated by the International Telecommunications Union (ITU), the Session Initiation Protocol (SIP), and Media Gateway Control Protocol (MGCP), to name a few.

For example, FIG. 1A illustrates a protocol stack 100a for a conventional H.323 implementation over an Ethernet IP network. One or more application programs 103a interface to the protocol stack 100a. The H.323 layer 101a includes a control layer 106 supporting H.245 control signaling for negotiation of media channel usage, Q.931 (H.225.0) for call signaling and call setup, and H.225.0 Registration, Admission and Status (RAS). The H.323 layer 101a may also include a data layer 108 supporting T.120 for data conferencing. The H.323 layer 101a further implements audio codecs 102 and may also implement video codecs 104. An RTP/RTCP layer 110 is provided for sequencing the audio and video packets. The H.323 layer 101a employs UDP and TCP 112 as its transport layer, and also employs an IP layer 114, and then, an Ethernet layer 116. Further details concerning the

H.323 Recommendation may be obtained from the International Telecommunications Union; the H.323 Recommendation is hereby incorporated by reference in its entirety as if fully set forth herein.

An important key to the development of ToL and VoIP systems is the development of successful Quality of Service (QoS) IP networks. Generally, QoS refers to the ability of a network to guarantee specific performance levels, related to network bandwidth, availability, jitter, security, and data loss. High voice and/or video quality communication require high QoS levels on all network segments involved in the communication. Guaranteed QoS has been of particular concern on Ethernet LANs, both due to the bursty nature of IP traffic and the CSMA/CD contention protocol used by Ethernet.

Several approaches to QoS in IP networks have employed the Type of Service (TOS) byte, i.e., the second byte, in the IP header. The TOS field is an eight-bit field that signals to routers in the network a priority of handling as well as parameters related to delay, throughput, cost, and reliability. Because the TOS field itself had not been widely used, in certain implementations, it has been recast as a "differentiated service" (DS) byte, which is used to indicate to routers the per-hop behavior expected at the node. These approaches, however, do not in themselves provide a Quality of Service. Other protocols, such as the Resource Reservation Protocol (RSVP) or IEEE 802.1p, are required to implement actual Quality of Service features. Even when the TOS/DS bits are used with such protocols, Quality of Service is not necessarily guaranteed network-wide.

As such, telephony vendors have been developing "Quality of Service Ethernet" (QoSEthernet), which lies between the IP layer and the Ethernet layer in the protocol stack and which provides a guaranteed QoS. Thus, FIG. 1B illustrates a protocol stack 100b including a QoSEthernet layer 115 between the IP layer 114 and the Ethernet layer 116. An exemplary QoSEthernet system is available from Path 1 Network Technologies, Inc., San Diego, California, and makes use of RSVP and the intserv process, described by the Internet Engineering Task Force (IETF).

In practice, implementation of the QoSEthernet layer 115 requires

modified application programs 103b in order to provide the required QoSEthernet information at call setup. That is, each application program(s) 103b must be modified, or replaced, to provide one or more commands in addition to standard H.323 commands in order to invoke the required QoS. Thus, to support QoSEthernet, a user must not only implement a QoSEthernet layer but also change applications programs, such as telephone, fax, and the like. Further, each application program requires setup and configuration, which can cause added costs and delays in implementation.

As such, there is a need for a system to be able to implement QoSEthernet without having to replace existing software systems. There is a still further need for a system to implement QoSEthernet while using TOS bits to specify the required QoSEthernet Quality of Service.

SUMMARY OF THE INVENTION

These and other drawbacks in the prior art are overcome in large part by a system and method according to the present invention. According to one implementation of the present invention, existing software sets TOS bits during IP encapsulation. A Generate QoSEthernet layer receives the TOS bits and translates them into a form compatible with the QoSEthernet requirements. In a particular implementation, the Generate QoSEthernet layer is embodied in an H.323 Recommendation telecommunication system.

According to one implementation of the invention, one or more telephony application programs are provided, along with an H.323 Recommendation stack, an IP layer, and modular Generate QoSEthernet and QoSEthernet layers. Either the Generate QoSEthernet layer or the QoSEthernet layer may be replaced or modified without necessarily having to modify the H.323 Recommendation stack and application program(s).

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention is obtained when the following detailed description is considered in conjunction with the following drawings in

which:

FIG. 1A and FIG. 1B illustrate exemplary program stacks according to the prior art;

FIG. 2 is a diagram of an exemplary telecommunications system according to an implementation of the invention;

FIG. 3 is an exemplary program stack according to an implementation of the invention;

FIG. 4 is a diagram of an exemplary generate quality of service Ethernet module according to an implementation of the invention;

FIG. 5 illustrates exemplary mapping of type of service bits to QoS Ethernet QoS levels;

FIG. 6 illustrates exemplary mapping of differentiated service bits to QoS Ethernet QoS levels; and

FIG. 7 is a flowchart illustrating operation of an implementation of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIGs. 2-7 illustrate an improved system and method for providing QoS in an Ethernet-type local area network. Existing software is used to generate TOS (Type of Service) values or DS (Differentiated Service) values when the data packets are encapsulated in the IP. A Generate QoSEthernet layer is provided that translates the TOS or DS bits into QoSEthernet-compatible commands. The QoSEthernet commands are then provided to a QoSEthernet layer.

Turning now to the drawings, and with particular attention to FIG. 2, a diagram illustrating an exemplary IP protocol telecommunications system 300 according to an embodiment of the present invention is shown. In particular, the IP protocol communication system 300 may be embodied as an H.323 Recommendation-compatible system. It is noted that, while described herein with regard to an H.323 network, the invention is equally applicable to any network such as MGCP (Media Gateway Control Protocol), SIP+ (Inter MGS Protocol), SGCP, MEGACO, and generally, any voice or multimedia over IP

scheme. Further, it is noted that an exemplary generic H.323 system is the HiNet™ RC3000 system, available from Siemens.

The telecommunications system 300 includes a local area network (LAN) or packet network 301 and, particularly, and Ethernet LAN. Coupled to the LAN 301 may be a variety of H.323 terminals 302a-d, a multi-point control unit (MCU) 306, an H.323 gateway 308, an H.323 gatekeeper 310, a LAN server 312, and a plurality of other devices such as personal computers (not shown). The H.323 terminals 302a-d are in compliance with the H.323 Recommendation. Further, the H.323 terminals 302a-d include Generate QoSEthernet controllers or layers 304a-d, as will be described in greater detail below.

More particularly, FIG. 3 illustrates a protocol stack according to an implementation of the invention. At the top are one or more application programs 103a. The application programs 103a, similar to those of FIG. 1A, may be embodied as one or more telephony programs, such as fax, voice, video, and the like. Next is an Internet Protocol voice communication stack, such as an H.323 protocol stack 101a, similar to that of FIG. 1A. Thus, the H.323 stack includes video codecs 102; audio codecs 104; a control layer 106 supporting H.245 control signaling for negotiation of media channel usage, Q.931 (H.225.0) for call signaling and call setup, and H.225.0 Registration, Admission and Status (RAS); a data layer 108 supporting T.120 for data conferencing; and an RTP/RTCP layer 110. The Internet Protocol voice communication stack 101a lies atop a UDP/TCP layer 112 and an IP layer 114. The application programs 103a are adapted to generate commands which are encapsulated in the second byte of the IP header as type of service (TOS) or differentiated service (DS) bits.

Also included are a QoSEthernet layer 115 and an Ethernet layer 116. Further, a Generate QoSEthernet layer 118 according to the present invention is provided. As will be described in greater detail below, the Generate QoSEthernet layer 118 intercepts the second byte of the IP header, derives a required QoS therefrom, and generates the appropriate QoS commands for the QoSEthernet layer 115.

Turning now to FIG. 4, an exemplary Generate QoSEthernet module 304 is illustrated in greater detail. The Generate QoSEthernet module 304 includes a control unit 402 coupled to a memory 404. The memory 404 includes one or more lookup tables or databases 406 for storing conversions between TOS or DS bits and QoSEthernet commands, as will be explained in greater detail below. Also included is a buffer unit 408, including an input buffer 410 and an output buffer 412. The input buffer 410 receives the TOS or DS bits and buffers them during access of the lookup table 406. The TOS and DS bits are then transferred to the output buffer 412 and the appropriate QoS commands are generated. The commands are then output from the output buffer to the QoSEthernet.

Turning now to FIG. 5, a diagram illustrating the principle of mapping of the TOS bits to QoS Ethernet commands is shown. FIG. 5 illustrates an exemplary TOS byte 502, a Generate QoS Ethernet map module 304a, and a QoS level mapped-to table 504. As is known, the first six bits of the Type of Service byte are used to define levels of service, ranging from “routine” to “critical.” The Generate QoSEthernet layer 304a according to the present invention reads the defined TOS bits and maps them to corresponding QoS Ethernet QoS levels.

FIG. 6 is a similar diagram of the differentiated service byte mapping. Shown is a Differentiated Service byte 602, an exemplary Generate QoS Ethernet layer map 304b, and a resulting QoS level table 604. Bits 6-7 are presently unused; bits 0-5 are presently used to define “per hop behavior,” i.e., a particular forwarding treatment at each node. The Generate QoS Ethernet layer 304b reads the DS byte 602 and maps the bits to a QoSEthernet quality of service level.

Operation of an implementation of the present invention is illustrated more clearly with reference to the flowchart of FIG. 7. In a step 702, the client terminal begins a call. In a step 704, the corresponding messages are encapsulated in IP packets. In a step 706, the second byte of the IP header is set according to predefined QoS levels. As discussed above, the second byte may be either a Type of Service byte or a Differentiated Service byte. In a

step 708, the second byte of the IP header is read by the Generate QoS Ethernet layer. In a step 710, the Generate QoSEthernet layer accesses the lookup table in memory for the corresponding QoSEthernet levels. Finally, in a step 712, the Generate QoSEthernet layer generates the required QoS Ethernet commands to establish the specified quality of service.

The invention described in the above detailed description is not intended to be limited to the specific form set forth herein, but is intended to cover such alternatives, modifications and equivalents as can reasonably be included within the spirit and scope of the appended claims.